

5

Apparatus for separating amalgam

10

Description

15 The invention relates to an apparatus for separating amalgam in accordance with the preamble of Patent Claim 1.

20 Dental amalgams are metal compounds of mercury, silver, zinc, copper. Due to their good physical properties amalgams are used to make fillings in dentistry. Whenever teeth are filled with amalgam fillings or when such fillings are drilled out to remove them amalgam waste occurs. Together with the rinsing water and the saliva sucked out from the patient's mouth such amalgam waste is transferred into the dentist's sewage system. In order to prevent such heavy metals from entering the waste water treatment system such amalgam particles need to be removed before entering the public sewerage system.

30 The use of centrifuges is known which separate amalgam particles from the sewage due to the higher density of such particles. The disadvantage when using centrifuges is that they need to be switched off at certain intervals in order to allow the draining of precipitation from the drums. In addition to this centrifugal separators require expensive technological equipment. They include moving parts, such as a rapidly rotating motor. The method is expensive and requires a high amount of maintenance. A permanent power supply is necessary. The collecting containers of the

35

5 separator must be regularly exchanged and their contents disposed of.

Also known are filtering separators which filter out the solid to be removed, such as amalgam in this case, from the dental sewage. Since amalgam contains a very high percentage of finest grain, the filters have the disadvantageous tendency to get choked and clogged very quickly.

15 Sedimentation separators use the settling characteristics of the relatively heavy amalgam particles. They provide an essentially horizontal water flow, the speed of which must be small enough as to allow the particles to deposit on the sedimentation surface due to their settling speed during their residence time. This requires short settling distances and large sedimentation surfaces. Amalgam sinks to the sedimentation surface and deposits there. The flow rate of the dental sewage must be low enough to ensure that the particles are not rinsed off the sedimentation surface again. To ensure the separating effect a maximum water flow must be determined.

WO 98/46 324 specifies an apparatus for separating solids from liquids by sedimentation, particularly for separating amalgam from water. This apparatus comprises a housing with flow and sedimentation zones. The sedimentation zone consists of a higher number of plates which are arranged horizontally and parallel to each other and whose surfaces provide extrusions and indentations which keep the plates at fixed distances to each other. Sewage is lead through the spaces between the plates in a laminar flow. During such passage the amalgam particles sediment on the surface of the plates. This apparatus is designed for multiple use and has the disadvantage, that the cleaning, i.e. the

5 removal of the deposited amalgam particles from the plates,
requires high efforts. The production of the plate package
made of special steel is very expensive and cost-intensive.
According to the regulation the separator must be provided
with a level meter. In this case the load amount is
10 determined in that the complete separator is put on an
external balance to measure the amount of deposited
amalgam. This increases the costs of amalgam separation in
a dentist's practise.

15 The object of the invention is to provide an apparatus for
separating amalgam comprising an easily producible
sedimentation surface, allowing to separate the deposited
amalgam from the apparatus in a very effective manner by
recycling the complete apparatus and enabling a level
20 measuring without using external instruments.

The solution of this task arises from the characteristics
of Patent Claim 1. Advantageous embodiments are specified
in the sub-claims.

25 So the apparatus according to the invention for separating
amalgam from dental sewage, consisting of a flow zone and a
sedimentation zone, which are arranged in a housing
providing an aperture for sewage supply and an aperture for
sewage discharge, characterised in that the housing, which
30 comprises an inlet chamber, a passage chamber which
contains a separator made of foil layers, and an outlet
chamber, is sealed in a liquid-proof manner, except for a
sewage inlet and a sewage outlet, and provides stands,
whereby in an advantageous embodiment the hollow interior
35 of such stands contains at least one pressure chamber which
is combined with pressure sensors measuring any pressure
changes.

5 In an embodiment of the invention the inlet chamber, the
passage chamber with the separator and the outlet chamber
are arranged horizontally one after the other seen in flow
direction, and with the sewage inlet and the sewage outlet
10 arranged in the highest position of the inlet chamber and
the outlet chamber respectively.

In an embodiment of the invention the separator is a form
body which can be streamed through consisting of several
tight fitting layers of a structured foil.
15

In another embodiment of the invention the separator is a
form body which can be streamed through consisting of
several tight fitting layers of a structured foil and a
plain foil that are arranged alternately.
20

According to another embodiment of the invention the
separator forming a form body consists of a wound
structured foil or a structured foil wound in combination
with a plain foil such that by simple winding of both
25 foils, or only of the structured foil, a form body is
created which can be streamed through in the longitudinal
direction.

In another embodiment of the invention the separator
forming a form body consists of tubular elements made of
structured foil, or structured foil and plain foil, which
are slit into each other.
30

In further embodiments of the invention the longitudinal
structures are formed by different plissé structures such
as triangles, quadrangles or trapezia. Furthermore it is
also possible to use lamellar, honeycombed or riffle
structures.
35

5 It is also preferred to form structured foil in a way such
that only scattered raised points or indentations are
provided. Other structures which are not explicitly named
here and also have a distance-keeping effect shall of
course also be covered by the term structured foil. The
10 optimum distances between the foil layers are between 1 and
10 mm.

In another embodiment the sedimentation surfaces of the
structured foil are roughened in order to achieve an even
15 better sedimentation of amalgam particles.

In another embodiment of the invention a perforated plate
is arranged between the inlet chamber and the passage
chamber, the holes of which provide sinkings on the side
20 that faces the flow.

Another essential advantage according to an embodiment of
the invention is a flow guidance element provided in the
inlet chamber that is arranged in the upper area of the
25 inlet chamber. Thus, in combination with the perforated
plate a laminar flow is generated in the flow channels of
the separator over the complete height of the housing. This
allows to completely fill the housing with water without
leaving dead space. Furthermore this ensures an
30 advantageous water trap effect.

In another embodiment of the invention, in the uppermost
position of the passage chamber above the separator a vent
channel is arranged which has a connection to the sewage
35 outlet in the outlet chamber. This enables any gases
forming in connection with the flow guidance or any
inclusions of air to gather in this vent channel and to be
removed from the apparatus directly via the sewage outlet.

5. A further embodiment provides a flow regulator in the sewage outlet.

10 In a particular embodiment of the invention the pressure chamber located in a stand comprises a gas-impermeable, elastic foil which bulges outward after being filled with air or another gas up to a slight excess pressure, so that when the mass of the apparatus increases due to the deposition of amalgam the foil is compressed thus generating a higher measurable pressure inside the pressure
15 chamber which serves as the measure for the level indicator. This requires that the level meter is connected with the pressure chamber in a pressure-sensory manner.

20 The apparatus according to the invention consists of recyclable synthetic material. It can be shredded and recycled completely after the amalgam was separated.

25 In the following the invention will be explained in detail by means of an embodiment and drawings.

In the figures

Fig. 1 shows a schematic longitudinal section of the apparatus with a wireless transmitting level
30 indicator,

Fig. 2 shows a schematic longitudinal section of the apparatus with an exterior level indicator located close to the outside of the apparatus,

35 Fig. 3 shows a cross section of the inlet chamber of the separator as seen in flow direction,

5 Fig. 4 shows a perspective exemplary illustration of the
 whole apparatus,

 Fig. 5 shows a perspective illustration of the longitudinal
 cross-section of the housing of the apparatus,

10

 Fig. 6 shows a schematic illustration of the separator
 consisting of tubular elements made of structured
 foil and plain foil, which are slit into each other,

15 Fig. 7 shows a schematic cross-sectional illustration of
 the separator in the wound-up version,

 Fig. 8 shows a schematic cross-sectional illustration of
 the separator with a square cross-sectional area
20 using separate tubular elements,

 Fig. 9 shows a schematic cross-sectional illustration of
 the separator in the wound-up version with a square
 cross section,

25

 Fig.10
 to

 Fig.16 show various embodiments of structured foil,

30 Fig.17 shows a schematic illustration of a combination of
 structured foil and plain foil,

 Fig. 18 shows a schematic perspective illustration of a
 separator, and

35

 Fig. 19 shows a cross section of the outlet chamber as seen
 against the flow direction.

5 Fig. 1 shows a schematic longitudinal section of the
apparatus according to the invention. Provided in the
interior of a housing 10 are an inlet chamber 40, a passage
chamber 50 and an outlet chamber 60. The housing 10
10 provides a handle 15 that allows the easy transport of the
apparatus. A stand (front) 13 and a stand (rear) 14 are
arranged at the bottom area of the housing 10, ensuring a
secure position of the apparatus. A sewage inlet 41 allows
the sewage to enter the inlet chamber 40. A flow element 42
15 extending into the inlet chamber from above, which
restricts the passage area by approximately 30 %, enables
the formation of a siphon-like water trap.

Sewage penetrates then through a perforated plate 20 in
which a higher number of holes 21 is arranged scattered
20 over the surface of the perforated plate 20, which holes
provide sinkings on the side that faces the flow. The
perforated plate 20 is fixed by an attachment (front) 11
and an attachment (rear) 12. A separator 30 is located in
the passage chamber 50 which is arranged behind the
25 perforated plate 20. The separator 30 is fixed in the
passage chamber 40 by the attachment (rear) and a retaining
edge 17. A vent channel 50 with a direct connection to the
outlet chamber 60 is provided above the separator 30 in the
passage chamber 50. This vent channel 51 which extends
30 approximately from the middle of the passage chamber 50 to
the outlet chamber 60 allows the gathering of any occurring
gasses or inclusions of air which can then be discharged
directly through a sewage outlet 61 of the outlet chamber
60.

35

A flow regulator 62 is located in the sewage outlet 61
which is arranged in the highest position of the outlet
chamber 60.

5 A level meter 70 is arranged inside or outside of the
housing 20. A pressure chamber 72 which is closed at the
bottom by a gas-impermeable and elastic foil 71 is provided
within the stand (rear) 14 as a part of such level meter.
10 Due to the slightly pressurized gas filling the foil 71 is
bulged outward such that the whole apparatus according to
the invention stands on a kind of air cushion on one side,
namely on the stand (rear) 14. The more amalgam deposits in
the separator, the higher is the pressure on the bulging
foil 71 thus increasing the pressure in the pressure
15 chamber 72. The pressure increase is proportional to the
mass increase of the apparatus.

A pressure sensor (wireless) 76 located in the pressure
chamber 72 is provided with a radio transmitter which
transmits the respective pressure data to a receiver 77
20 that is located outside the housing, and when a certain
limit is reached an integrated alarm box 74 gives an
acoustic or visual signal indicating that the apparatus is
completely loaded with amalgam. In this case the complete
apparatus is removed from the dental sewage network and
25 taken to a waste disposal system where due to the given
material and construction according to the invention the
whole apparatus will be shredded and the sedimented
amalgam separated in an easy manner.

After removing the filled apparatus a new apparatus can be
30 easily installed in the doctor's practise.

Fig. 2 shows a second version of level measuring, wherein
via a pressure duct 73 extending through a wall 16 of the
housing 10 any pressure changes occurring in the pressure
chamber are directly transmitted to a pressure sensor 75
35 located on the outside, which carries out the necessary
electronic processes that induce the alarm box 74 to
indicate the maximum filling level of the apparatus.

5 Fig. 3 shows a cross section of the apparatus according to the invention with the cross section carried out before the perforated plate 20 as seen in flow direction. The holes 21 of the perforated plate 20 ensure that bigger particles contained in the dental sewage are retained in this place.
10 The sinking 22 prevents here a clogging of the smaller holes 21. After the housing 10 is completely filled with water the flow guidance element 42 which is arranged directly behind the water inlet 41 acts as a water trap.

15 Fig. 4 shows by way of example a perspective illustration of the general view of an apparatus according to the invention depicting the sewage inlet 41, the sewage outlet 61 as well as the vent channel 51 and the pressure chamber 72. The handle 15 allows the easy transport of the
20 apparatus.

The apparatus cannot be opened any more in this state. The amalgam is removed after the apparatus is destroyed completely, e.g. by shredding.

25 Fig. 5 shows also by way of example an exploded perspective view of the apparatus according to the invention. After the installation of the perforated plate 20 and the separator 30 the two halves of the housing 10 depicted here are bonded or sealed to each other. An option for opening the
30 apparatus is not provided because the complete apparatus once filled with a maximum amount of amalgam is replaced by a new apparatus, while the filled apparatus will be shredded, the amalgam separated and all the material recycled.

35

The form depicted in Fig. 4 and Fig. 5 in perspective illustration is a preferred cylindrical form, as the manufacturing of the cylindrical form of the separator 30 formed of structured foil 32 and plain foil 34 is

5 particularly advantageous. The housing 10 that is depicted
here can be produced in different ways, particularly
preferred is injection moulding. The housing 10 comprises
the preformed inlet chamber 40, passage chamber 50 and
outlet chamber 60, whereby the perforated plate 20 is fixed
10 between the attachment (front) 12 and the attachment (rear)
11 and the separator 30 is installed in the passage chamber
50. Also in the cylindrical version, the upper section of
the housing 10 provides the sewage inlet 41 and the sewage
outlet 61 at the ends of the cylindrical form which due to
15 their shape can be connected by means of sewage tubes or
pipes. The vent channel 51 arching upward extends from the
middle of the housing 10 to the sewage outlet 61 to ensure
that occurring gasses or trapped air can enter the sewage
outlet 61 easily. The external stand (front) 13 and the
20 stand (rear) 14 ensure the stability of the apparatus.
According to the invention a pressure chamber 72 is
arranged in the hollow spaces provided in such stands, and
this pressure chamber 72 as part of the level meter 70
enables an exact loading density with amalgam.

25 Fig. 6 to Fig. 9 depict cross-sectional versions of the
separator 30 made of a structured foil 32 and a plain foil
34.

30 Fig. 6 and Fig. 8 show particularly those combinations of
the structured foil 32 and the plain foil 34 which are made
of tubular elements which were slit into each other, while
Fig. 7 and Fig. 9 show versions where the two combined
foils, the structured foil 32 and the plain foil 34, are
35 wound up.

Fig. 10 to Fig. 16 show by way of example various types of
the structured foil 32, which can be combined with a plain
foil 34, as depicted in Fig. 17, by putting one foil on top

5 of the other and subsequently winding up the two foils
until the separator 30 has the form required to ensure that
when introducing it into the passage chamber 50 the latter
is filled completely. This form is depicted, for example,
in Fig. 18 in a perspective view.

10

Fig. 19 depicts a cross section of the apparatus as seen
against the flow direction of the sewage, showing the
separator 30 when introduced in the passage chamber 50.
Arranged above the separator 30 is the vent channel 51 as a
15 protrusion of the housing 10.

5

List of Reference Numerals

	10	housing
	11	attachment (rear)
10	12	attachment (front)
	13	stand (front)
	14	stand (rear)
	15	handle
	16	wall
15	17	retaining edge
	20	perforated plate
	21	hole
	22	sinking
20	30	separator
	31	flow channel
	32	structured foil
	33	wall
25	34	plain foil
	40	inlet chamber
	41	sewage inlet
	42	flow guidance element
30	50	passage chamber
	51	vent channel
	60	outlet chamber
35	61	sewage outlet
	62	flow regulator
	70	level meter
	71	foil

5	72	pressure chamber
	73	pressure duct
	74	alarm box
	75	pressure sensor
	76	pressure sensor(wireless)
10	77	receiver